

WHAT IS CLAIMED IS;

1. A water-repellent film-coated article comprising  
a substrate and

a water-repellent film, composed of silicon oxide and at  
5 least one of metal oxide selected from the group consisting  
of magnesium oxide, calcium oxide, strontium oxide and boron  
oxide and having a water-repellent group, coated on the surface  
of the substrate.

10 2. A water-repellent film-coated article according to  
claim 1, wherein said water-repellent film contains

silicon oxide at 70-99 mole percent (based on  $\text{SiO}_2$ ),

at least one of metal oxide selected from the group  
consisting of magnesium oxide, calcium oxide, strontium oxide  
15 and boron oxide at a total of 1-30 mole percent (based on  $\text{MgO}$ ,  
 $\text{CaO}$ ,  $\text{SrO}$  and  $\text{BO}_{3/2}$ ), and

a water-repellent group at 0.01-20 wt%.

3. A water-repellent film-coated article according to  
claim 2, wherein said water-repellent film further contains,  
20 in terms of mole percent, at least one of metal oxide selected  
from the group consisting of zirconium oxide, aluminum oxide,  
gallium oxide, indium oxide, scandium oxide, yttrium oxide,  
lanthanum oxide, cerium oxide, cobalt oxide, iron oxide, nickel

oxide, copper oxide and zinc oxide at 0.5-5%, based on  $\text{ZrO}_2$ ,  $\text{AlO}_{3/2}$ ,  $\text{GaO}_{3/2}$ ,  $\text{InO}_{3/2}$ ,  $\text{ScO}_{3/2}$ ,  $\text{YO}_{3/2}$ ,  $\text{LaO}_{3/2}$ ,  $\text{CeO}_{3/2}$ ,  $\text{CoO}$ ,  $\text{FeO}_{3/2}$ ,  $\text{NiO}_2$ ,  $\text{CuO}$  and  $\text{ZnO}$ .

4. A water-repellent film-coated article according to  
5 claim 1, wherein said water-repellent film contains

silicon oxide at 70-98 mole percent (based on  $\text{SiO}_2$ ),  
magnesium oxide and/or calcium oxide at 1-29 mole percent  
(based on  $\text{MgO}$  and  $\text{CaO}$ ),

boron oxide and/or zirconium oxide at 1-29 mole percent  
10 (based on  $\text{BO}_{3/2}$  and  $\text{ZrO}_2$ ) and

a water-repellent group at 0.01-20 wt%.

5. A water-repellent film-coated article according to  
claim 4, wherein said water-repellent film further contains,  
in terms of mole percent, at least one of metal oxide selected  
15 from the group consisting of aluminum oxide, gallium oxide,  
indium oxide, scandium oxide, yttrium oxide, lanthanum oxide,  
cerium oxide, cobalt oxide, iron oxide, nickel oxide, copper  
oxide and zinc oxide at 0.5-5%, based on  $\text{AlO}_{3/2}$ ,  $\text{GaO}_{3/2}$ ,  $\text{InO}_{3/2}$ ,  
 $\text{ScO}_{3/2}$ ,  $\text{YO}_{3/2}$ ,  $\text{LaO}_{3/2}$ ,  $\text{CeO}_{3/2}$ ,  $\text{CoO}$ ,  $\text{FeO}_{3/2}$ ,  $\text{NiO}_2$ ,  $\text{CuO}$  and  $\text{ZnO}$ .

20 6. A water-repellent film-coated article according to  
any one of claims 1 to 5, wherein said water-repellent group  
is an alkyl group or fluoroalkyl group.

7. A water-repellent film-coating composition

containing

- (A) a thoroughly hydrolyzable silane compound,
- (B) a silane compound with a water-repellent group,
- (C) an acid and

5        (D) a compound of at least one of metal selected from  
the group consisting of magnesium, calcium, strontium and  
boron.

8. A water-repellent film-coating composition according  
to claim 7 which contains said silane compound (A) at 0.01-2  
10 wt% based on  $\text{SiO}_2$ , said silane compound (B) at 0.00001-0.15  
wt% based on  $\text{SiO}_2$ , said acid at 0.001-3 N, water at 0-5 wt%  
and said compound (D) at a molar ratio of 0.01-0.4, based on  
MgO, CaO, SrO and  $\text{BO}_{3/2}$ , with respect to said silane compound  
(A).

15        9. A water-repellent film-coating composition according  
to claim 7 or 8 which contains an alcohol as a solvent.

10. A water-repellent film-coating composition  
containing

- (A) a thoroughly hydrolyzable silane compound or its  
20 hydrolysate at 0.01-2 wt% (based on  $\text{SiO}_2$ ),
- (B) a silane compound with a water-repellent group at  
0.00001-0.15 wt% (based on  $\text{SiO}_2$ ),
- (C) an acid at 0.001-3 N,

(D-1) a magnesium and/or calcium compound at a molar ratio of 0.01-0.4, based on MgO and CaO, with respect to said silane compound (A) (based on SiO<sub>2</sub>),

(D-2) a boron and/or zirconium compound at a molar ratio  
5 of 0.01-0.4, based on BO<sub>3/2</sub> and ZrO<sub>2</sub>, with respect to said silane compound (A) (based on SiO<sub>2</sub>),

(E) a compound of at least one of metal selected from the group consisting of cobalt, iron, nickel, copper, aluminum, gallium, indium, scandium, yttrium, lanthanum, cerium and zinc  
10 at a molar ratio of 0-0.4, based on CoO, FeO<sub>3/2</sub>, NiO<sub>2</sub>, CuO, AlO<sub>3/2</sub>, GaO<sub>3/2</sub>, InO<sub>3/2</sub>, ScO<sub>3/2</sub>, YO<sub>3/2</sub>, LaO<sub>3/2</sub>, CeO<sub>3/2</sub> and ZnO, with respect to said silane compound (A) (based on SiO<sub>2</sub>), and

(F) water at 0-20 wt%.

11. A water-repellent film-coating composition  
15 according to claim 10 which contains an alcohol as the solvent.

12. A water-repellent film-coating composition according to any one of claims 7 to 11, wherein said silane compound (A) is a tetraalkoxysilane or tetrachlorosilane.

13. A water-repellent film-coating composition  
20 according to any one of claims 7 to 12, wherein said acid is hydrochloric acid, nitric acid, acetic acid, formic acid or trifluoroacetic acid.

14. A process for preparation of a water-repellent

film-coated article, characterized by applying a water-repellent film-coating composition according to any one of claims 7 to 13 onto a substrate surface and drying it.

15 15. A process for preparation of a water-repellent film-coated article according to claim 14, wherein said drying is carried out at room temperature.

16. A process for preparation of a water-repellent film-coated article according to claim 14 or 15, wherein said drying is carried out in an atmosphere at 40% relative humidity  
10 or lower.

17. A process for preparation of a water-repellent film-coated article according to any one of claims 14 to 16, wherein said drying is followed by heating at a temperature of from room temperature up to 300°C.

15 18. A process for preparation of a water-repellent film-coated article according to any one of claims 14 to 16, wherein said drying is followed by heating at a temperature of from room temperature up to 150°C.

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